READING PASSAGE

The Power of Batteries

Learn the fascinating history and science behind this groundbreaking electrical invention.

Batteries power so many things in your everyday life that you probably don't think twice about them. Around 1800, an Italian physicist and chemist named Alessandro Volta created a simple battery called the voltaic pile, but before then there was no such thing as portable electricity. In his experiments, Volta found that stacked disks of copper and zinc, separated by cloth or paper soaked in a salty solution, would produce a small amount of electrical energy (see diagram on next page). The energy was the result of a chemical reaction known as **oxidation reduction**, or **redox** for short.

IN THE CHEMISTRY LAB

If you connect the positive and negative terminals of a voltaic cell with a wire, the zinc begins to lose its electrons in a process called oxidation. They then move toward the copper in a process called reduction (you can remember this as: Because electrons are negative, they reduce positive charge).

Oxidation reduction is an **exothermic reaction**, meaning that energy is released as the reaction occurs. Volta's discovery meant that **potential chemical energy** could be "stored" in a battery and used in the form of electrical energy whenever the time was right. The more voltaic cells that were stacked, the greater the voltage.

MODERN INNOVATORS

The invention of the battery made power supply portable, but the practical applications of the voltaic cell were very limited. Enter the innovators who continued to improve the battery by engineering and experimenting with new materials, creating batteries that were more reliable, more powerful, easier to use, and longer-lasting. Notable advances in battery science include:

The Daniell Cell: the first practical source of portable power that provided a longer and more reliable current than Volta's. Example application: telegraphy.

Lead-Acid Battery: the first battery that could be recharged. Example application: car battery.

The Dreaded Dead Battery

How annoying is it when your cell phone battery dies? With any battery, eventually the anode has no more electrons to supply, and the battery will die or go flat. **Some batteries, like the one in your phone, are designed to be rechargeable**. The same electrochemical processes that allowed the battery to supply power are reversed using an external power supply (such as plugging a cell phone into its charger). The reverse flow of electrons restores the battery's power-giving abilities.

Photo: Solar battery: Andreas Schlegel/fStop/Offset; various batteries: fmajor/iStock

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Zinc-Carbon Battery: the first dry-cell battery. Unlike wet cells, the zinc-carbon battery would not spill and did not have to be kept upright. Example application: flashlight.

Alkaline Battery: achieved better energy density (could store more energy per unit of volume) than its predecessors. Example application: television remote.

Lithium-Ion Battery: significant advancements in energy density and the ability to recharge more than a thousand times. Example application: cell phone.

In the future, you may be using batteries that are paper-thin and have the ability to recharge hundreds of thousands of times. As with any innovation process, though, there will be setbacks along the way. Batteries have their share of problems, including both safety and environmental concerns. A battery that has significant energy density, for instance, will cause a dangerous explosion if its cathode and anode accidentally come into contact. Over their history, batteries have been manufactured using heavy metals such as mercury and lead along with other components. They must be recycled responsibly because they pose a threat to humans and the natural environment.

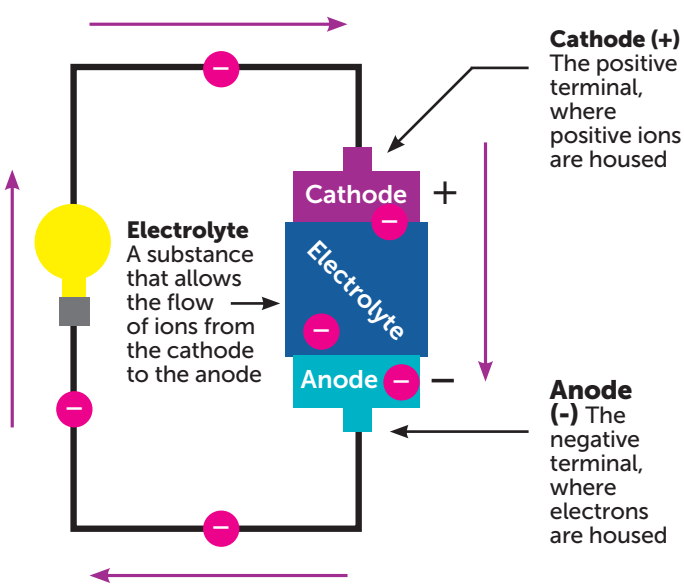
Are you the next innovator? How could you make a battery that is more environmentally friendly? A battery that holds a charge longer that is lighter, smaller, safer, or stronger?

What's a frog got to do with it? Do a quick online search to find out how the very curious behavior of a dead frog inspired Volta's battery experiments.

Or what about a battery that could recharge an infinite number of times? Challenge yourself to come up with the next great idea!

The Anatomy of a Battery

A battery you bought at the store last week and the earliest versions of batteries have the same three components in common. Check out the diagram below: When a wire closes the circuit or connects the cathode and the anode, electrons: a) move into the wire from the anode, b) power a device, and c) continue on their way back to the cathode.



Cathode (+) The positive terminal, where positive ions are housed

Electrolyte A substance that allows the flow of ions from the cathode to the anode

Anode (-) The negative terminal, where electrons are housed

Voltaic Pile

The voltaic pile is made up of individual cells that are stacked to increase the amount of voltage.